A Revision of the Older Tertiary Mollusca of Australia

Part I.

By Professor Ralph Tate.

[Read September 5, 1899.]

In 1880, I commenced the publication of a series of essays on the Mollusca of the Older Tertiaries of Australia, still far from completion; since that time many additional species have been obtained, a large number of which await diagnostic descriptions, other authors have occupied themselves with the fauna, and my opinions regarding some of the species have been changed as the result of fuller acquaintance with them and their related species. Taken altogether, it seems desirable to submit an up-to-date knowledge of the Molluscan constituents of our Older Tertiary faunas, so far, at least, as concerns those groups which have been systematically dealt with by me in the pages of these Transactions.

The "Revision" will consist of a list of admitted species under their revised generic and specific names, will include full references to additional species and diagnoses of new ones. The locality records will be given in full, these are based on specimens in the University Museum, Adelaide, for the great part, and on those that I have studied in other collections; other records than these are indicated by the suffixed names of the authors responsible for their determinations. Synonyms are the result of a comparison of types or of well-authenticated examples, unless otherwise stated. The localities of the types are printed in distinctive type.

The geological horizons admitted for the present are Eocene, Post-Eocene, and Miocene, as set forth more in detail in Trans. Roy. Soc., S.A., Vol. XXIII., p. 197, 1899.

The retrospective references under each species will not extend beyond the respective essays of mine on which this Revision is based, as prior references, unless involving misrepresentations, are therein contained. The chief bibliography of later date will be given under each class to which the publications indicated respectively refer.

CLASS PALLIOBRANCHIATA.

The geological distribution of Palliobranchs in Cainozoic horizons in Australia is very restricted, as with the exception of *Magasella Cumingiana*, a recent species in Post-tertiary deposits at the Tintinara bore, Tatiara Desert, at a depth of 154-160 feet. and of a species of Terebratella, *T. pumila*, in the Miocene at Gippsland Lakes, the whole fauna is of Eocene age, or, perhaps, extending to Oligocene. *Rhynchonella Baileyana* was wrongly attributed to the Australian Miocene. A few Eocene species had been listed as belonging to the Miocene fauna at Grange Burn and Muddy Creek near Hamilton; but as all examples collected, since full knowledge was gained that two distinct faunal horizons were in contact at those localities, exhibit the characteristic features of a derivative source, the species in the Hamilton Miocene are not considered to be of endemic origin.

Bibliographical Reference.

1. *Tate*, "On the Australian Tertiary Palliobranchs," Tran. Roy. Soc., S. Aust., vol. III., 1880, pp. 140-170, plates 7-11.

A contribution of apparent importance is plate 33 in R. M. Johnston's "Geology of Tasmania," 1888. This plate is devoted to the illustration of fifteen species of Tertiary Brachiopoda, some of them are reputed by the author to occur at Table Cape; however, as the figures are bad copies of those in my monograph, the local records based thereon are of no value. On pages 232 and 233 of the same work is a list of our Palæogene Brachiopods showing provincial occurrences in parallel columns. The Tasmanian list I can only revise from the collection made by me on two separate visits to Table Cape; and I am constrained to reject some of the names, as I have good reason to believe they were introduced through faulty identifications. In this connection I urge that a mere superficial examination is not always reliable, and that in several instances actual dissection is necessary to resolve the similitudes, such as are presented by *Terebratula vitreoides* and *Terebratella Tepperi*; *Magellania insolita* and *Terebratella furculifera* (adult); *Terebratula Aldingæ* and *Terebratella furculifera* (junior); *Terebratella Woodsii* and *Magasella lunata*.

FAMILY TEREBRATULIDÆ.

Genus Terebratula, *Bruguière*.

T. vitreoides, *T. Woods*, 1878, non Tate, **1**, p. 144. Pl. viii., fig. 5.

Post-Eocene.—Table Cape, Tasmania.

T. Tateana, *T. Woods*, 1878; *T. vitreoides*, Tate, **1**, p. 144; non *Waldheimia Tateana*, Tate, **1**, p. 150. Pl. viii., fig. 2.

My intrepretation of the two species of *Terebratula* in the Table Cape-beds, named as above, by Tenison-Woods, proves to be wrong, as the result of an examination of numerous examples, collected by myself, and of a careful study of Woods' indifferent figures.

The commoner shell is elongate-oval with a more or less biplicate front; the beak somewhat laterally compressed and somewhat protruding; the foramen, which is obliquely truncated, is narrow oval. Young shells of this species, which T.-Woods named *T. Tateana*, have all the features of the adult. I have traced them up to larger than the examples figured by me, **1**, t. 8, f. 5 *a—b*, t. 10, f. 7, as *T. vitreoides*, In wrongly attaching that name I was influenced by the fact that the specific character was in the name, as *Tateana* much more resembles *vitrea* than *vitreoides* does.

The less common species, *T. vitreoides*, T.-Woods, is orbicular in outline varying to subpentagonal oval, the beak is almost flush with the umbo of the brachial valve, the foramen is very large and circular; young shells of eight millimetres diameter are the counterparts of the adults, which have the following measurements :—Transverse diameter, 24; longitudinal diameter, 26; sectional diameter, 12; diameter of foramen, 3 x 4 mm.

T. vitreoides resembles *Terebratella Tepperi*, and it is highly probable that Johnston and Pritchard have erroneously so named it.

Young and old shells of *T. Tateana* and *T. vitreoides* have proved on dissection to belong to Terebratula.

T. vitreoides differs from *Tateana* by its orbicular outline, absence of a mesial biplication, and the much abbreviated beak and larger foramen.

Localities.—Eocene—Aldinga Bay, Adelaide-bore, and River Murray Cliffs (South Australia); Muddy Creek, Gelibrand River, Mornington, Moorabool Valley, Corio Bay, Mitchell River, Shelford (Victoria).

Post-Eocene.—Spring Creek (Victoria), and Table Cape (Tasmania).

T. Aldingæ, *Tate*, **1**, p. 144.

Eocene.—Aldinga Bay, in the glauconitic limestone, S. Aust.; Cape Otway, Victoria (a doubtful identification); also New Zealand.

T. subcarnea, *Tate*, **1**, p. 144.

Eocene.—Chalk-cliffs, Great Australian Bight.

A very large Terebratulid occurs in the indurated clays of the Aldingian Section; the specimens are invariably much crushed, but the best and only specimen in the collection indicates a much compressed lenticular shell, with an almost circular marginal out

line of about 70 mills. diameter, and a thickness of 20 mm. (but it will be probably a little more in a perfect specimen). The surface is smooth, the growth-folds few and somewhat lamellar, and imbricating at the sides; the test is thick, as much as 2 mm. in the umbonal region, and densely punctate. On account of the thickness of test, probably, there is no external indication of a mesial septum. It may be a very large form of *T. subcarnea*, but if it be a *Magellania*, then it is new, and I suggest for it the name *M. cyclica*. It cannot be an extremely large *M. insolita*, which is the only Australian species that makes an approach to it, but that shell is elongate-oval, the beaks attenuated and sub-erect, exposing a broad and high deltidial area, and a small foramen, in contrast with the circular outline, stout incurved beak, and a moderately-sized foramen.

Genus Magellania, *Bayle*, 1880 (*nomen mutandum*).

Waldheimia, King, 1849, non Brullé, 1846.

M. corioensis, *McCoy*, 1877 ; *id.*, *Tate*, 1, p. 156.

Eocene.—Mannum (S. Aust.); Corio Bay, Muddy Creek, Mornington (Vict.). Post-Eocene.—Spring Creek near Geelong (Vict.).

M. (?) Crouchii, *T. Woods*, 1865 ; *id.*, *Tate*, 1, p. 153.

Eocene.—Mount Gambier (S. Aust.).

M. (?) divaricata, *Tate*, 1, p. 149.

Eocene.—River Murray Cliffs at Mannum (S. Aust.); Moorabool and Spring Creek (*Hall* and *Pritchard*).

M (?) fimbriata, *Tate*, 1880, 1, p. 150.

Eocene.—Aldinga Bay (S. Aust.); Cape Otway (Vict.).

M. furcata, *Tate*, 1, p. 148.

Eocene.—Moorabool Valley (*Hall* and *Pritchard*), Cape Otway (Vict.); Aldinga Bay and Port Vincent (S. Aust.).

M. Garibaldiana, *Davidson*, 1862; *id.*, *Tate*, 1, p. 146.

Eocene.—River Bremer near Callington, River Murray Cliffs, Croydon-bore 1,000 ft. (S. Aust.); Muddy Creek, Gelibrand River, Mornington, Moorabool Valley, Corio Bay, Airey's Inlet and Shelford (Victoria).

Post-Eocene.—Table Cape (Tasmania).

M. grandis, *T. Woods*, 1865; *id.*, *Tate* 1, p. 152.

Eocene.—River Murray Cliffs and Mount Gambier (S. Aust.); Shelford and Maude (Vict.).

Post-Eocene.—Table Cape (Tasmania).

M. gravida, *Suess*, Voy. Novara, Palæont., p. 56, t. 9, fig. 5 (*Waldheimia*).

Waldheimia concentrica, Hutton, Cat. Tert. Moll., N.Z., p. 35, 1873.

Terebratula (?) bulbosa, Tate, 1, p. 145.

Professor Hutton writes me, "I think that *T. Tayloriana*, Colenso, Tasmanian Jour. of Science, 1844, is the same." However, that name cannot be employed as it was preoccupied in *Terebratula* by Lea, 1841.

Eocene (?).—Edithburg, St. Vincent Gulf (S.A.).

Eocene (Oamaru Formation).—New Zealand.

M. insolita, *Tate*, 1, p. 151, t. 9, f. 6*b*. (non. 6*a*).

Waldheimia tapirina, Hutton, Cat. Tert. Moll., N.Z., p. 36, 1873.

Hutton's name is virtually a *nomen nudum*, as the diagnosis is absolutely devoid of specific characters, and is unaccompanied by a figure.

Eocene.—Mount Gambier, Aldinga Bay, and Adelaide-bore (S.A.); Muddy Creek, Camperdown, Gelibrand River, Cape Otway, Morington, Corio Bay, Bairnsdale (Vict.); also New Zealand.

Post-Eocene.—Spring Creek (Victoria).

M. Johnstoniana, *Tate*, 1, p. 151.

Eocene.—Aldinga Bay (South Australia).

M. MacLeani, *Tate*, 1, p. 153.

Eocene.—River Murray Cliffs at Murbko (S. Aust.); Moorabool Valley (Vict.), *teste* Hall and Pritchard.

M. pectoralis, *Tate*, 1, p. 157.

Eocene.—Aldinga Bay and Happy Valley (S. Aust.).

M. sufflata, *Tate*, 1, p. 157.

? Waldheimia triangulare, Hutton, *op. cit.*, p. 36, 1873.

Eocene.—Aldinga Bay, coast cliffs from Port Vincent to Stansbury (S. Aust.); possibly also New Zealand.

M. Tateana, *Tate*, 1, p. 150.

This species simulates *Terebratula Tateana*, T.-Woods, to which I had wrongly referred it, but the figures and diagnosis furnished by me belong to the present species and not to that of Woods. The generic distinctions for each cannot be called in question.

Eocene.—Aldinga Bay; Port Vincent, Stansbury and Muloowurtie, Yorke-Pen. (South Australia). Gelibrand River (Victoria).

M. Taylori, *Etheridge*, 1876; *id. Tate*, 1, p. 155.

Eocene.—River Murray Cliffs near Morgan (South Australia).

M. Vincentiana, *Tate*, 1, p. 154.

Waldheimia gravida, Hutton, Cat. Tert. Moll., N.Z., p. 36, 1873 (non Suess).

Eocene.—Port Vincent on Yorke Peninsula (South Australia), also New Zealand (Oamaru Formation).

Genus Terebratulina, *D'Orbigny*, 1847.

T. catinuliformis, *Tate*, 1896, T. Roy. Soc., S. Aust., p. 130, *nom. mut.* *T. Davidsoni*, Etheridge, 1876; *id.* Tate, 1, 158, non Boll, 1856; non King, 1871.

Eocene.—River Murray Cliffs, Aldinga Bay, Port Vincent and Stansbury, Mount Gambier, Croydon-bore near Adelaide (968—1,230 ft.), Mulgurdawa-bore near Wellington (213 ft.), (South Australia); Muddy Creek, Moorabool Valley, Birregurra, Shelford (Victoria).

Post-Eocene.—Beaumaris (Cheltenham) and Spring Creek (Victoria); Table Cape (Tasmania).

T. lenticularis, *Tate*, 1, p. 159.

Eocene.—River Murray Cliffs, Aldinga Bay, Adelaide-bore, and Muloowurtie near Ardrossan (S. Aust.); Muddy Creek and Corio Bay (Victoria). Waurn Ponds (*Hall* and *Pritchard*).

T. Scoulari, *Tate*, 1, p. 158.

Terebratella Suessi, Hutton, Cat. Tert. Moll., N.Z., 1873, p. 37.

Eocene.—River Murray Cliffs, Aldinga Bay, Adelaide-bore, Kingscote (Kangaroo Island), Muloowurtie (S. Aust.); Muddy Creek, Gelibrand R., Mornington, Maude (*Hall* and *Pritchard*), Corio Bay, Moorabool Valley, Shelford and Camperdown (Victoria); also New Zealand (Oamaru Formation).

Post-Eocene.—Table Cape (Tasmania).

Hutton's definition does not contain a single specific character; it will apply equally well to any of the species of the *caput-serpentis* group; moreover, the generic reference is absolutely wrong.

T. triangularis, *Tate*, 1, p. 159.

Eocene.—Aldinga Bay and Chalk-cliffs of the Great Australian Bight (S. Aust.); Cape Otway (Victoria).

Genus Terebratella, *D'Orbigny*, 1847.

T. furculifera, *Tate*, 1, p. 161.

Eocene.—Chalk cliffs of the Great Bight, Aldinga Bay, and Adelaide-bore (S. Aust.); also New Zealand.

The specimens from the Great Bight, incorrectly referred to *Waldheimia insolita*, prove on dissection to belong to *Terebratella* and to the species *furculifera*. They are adult, as indicated not only by greater size than the type, but by the large development of the deltidial pieces, which have coalesced to form a broadly triangular area, medially and axially ridged, thus reducing the

foramen to a relatively small circular aperture. Height, 25 length, 22·5; sectional diameter, 10·5 mm.

T. (?) pentagonalis, *Tate*, 1, p. 161.

Eocene.—Aldinga Bay (S. Aust.).

T. Tepperi, *Tate*, 1, p. 160.

Eocene.—"Muloowurtie Clays," near Ardrossan, Yorke Peninsula (S. Aust.).

T. Woodsii, *Tate*, 1, p. 161.

Post-Eocene.—Table Cape (Tasmania); Spring Creek (Victoria), *teste*, Hall and Pritchard.

I have collected a few examples of a terebratulid which is evidently the shell attributed to *Magellania corioensis*, McCoy, by Tenison-Woods, and my tentative reference of it to *Terebratella* proves to be correct; as it possesses a loop very similar to that of *T. furculifera*, though the diverging portions of it are minutely and distantly toothed on the margin. The largest specimen measures:—Transverse and longitudinal diameters, 12; sectional diameter, 5·5 mm.

Terebratella, *sp.*

A unique specimen from the Eocene clays at Cape Otway, Victoria, consisting only of the umbonal portions of both valves in apposition, and displaying the interior, indicates a species related to *T. Tepperi*, but with much inflated valves of an elongate-oval shape in marginal outline.

Terebratella pumila, *spec. nov.* Pl. viii., fig. 1.

The largest of three specimens from the Miocene at the Gippsland Lakes is of a somewhat circular outline, 5 mills. in diameter, depressedly convex, and its front margin slightly depressed. It has the large foramen of *Terebratella*; the interior displays a low mesial septum rising high into the interior at its anterior extremity in about the centre of the valve, and showing on it traces of lateral rods. (The specimen has been sacrificed to gain this knowledge.) It is most certainly distinct from any described species, and is of interest as being the first indication of a Palliobranchiata in our Miocene deposits.

[*T. Gaulteri* (Morris), Hutton, Cat. Tert. Moll., N.Z., p. 37, 1873, of the Oamaru Formation proves on dissection to be a *Rhynchonella.*]

Genus Magasella, *Dall*, 1870.

M. compta, *Sowerby*, 1845; *id.*, *Tate*, 1, p. 162.

Eocene.—River Murray Cliffs at Mannum; near Callington; Parrikie Well, 60 miles east of Cook's Plains; Muloowurtie, Port Vincent, and Stansbury, Yorke Peninsula (South Austr.).

Muddy Creek, Gelibrand River, Maude, Mitchell River, Camperdown, Moorabool Valley, Portland (*Woods*), Port Fairy (*Strezlecki*) (Victoria).

Post-Eocene.—Beaumaris and Spring Creek (Victoria).

M. deformis, *Tate*, 1, p. 165.

Eocene. — Aldinga Bay, Muloowurtie, Kangaroo Island (South Australia).

M. lunata, *spec. nov.* Pl. viii., figs. 3-3*a*.

Eocene.—Croydon-bore, near Adelaide, at from 400 to 1,230 feet; River Murray Cliffs at Mannum; Mulgurdawa-bore, near Wellington, at 213 ft. (South Australia). Belmont near Geelong (Vict.)

Shell small, surface smooth or with a few distant depressed growth-folds, largely and copiously punctated (visible under a pocket lense) about 250 pores in a field of 1·1 mills. diameter; suborbicular to subpentagonally oval in marginal outline, plano-convex in sectional outline; hinge-line arched, not so long as the greatest width of the shell.

Pedunculated valve medially elevated, its front margin indented by a deep, narrow, concave sweep corresponding with the medial elevation. The beak is of moderate size, hardly up-curved, its truncated foramen being nearly flush with the umbonal area of the brachial valve; foramen of moderate size.

Brachial valve flat except towards the front, where it is abruptly depressed in the middle line.

The internal characters are the same as in *M. deformis*, the septum reaches nearly to the opposite valve.

Dimensions of an average-sized specimen. — Length, 5·5; height, 6; sectional diameter, 2·5 mills.

The species is related to *M. deformis*, but differs by more orbicular outline, stout and short beak, larger foramen and flat brachial valve. It simulates *Terebratella Woodsii*, but its anterior depression is shallower and more abrupt. The numerous examples, all of a nearly uniform size, from the Croydon-bore should dispel the doubt that they are young forms of *M. Woodsiana*, which does not occur there.

M. Tenisoni, *Woods*, 1865; *id.*, *Tate*, 1, p. 165.

Eocene.—Mount Gambier (S. Aust.) and Portland (Vict.) [*Woods*].

M. Woodsiana, *Tate*, 1, p. 163.

Eocene.—River Murray Cliffs, Mount Gambier, Aldinga Bay (S. Australia); Muddy Creek, Gelibrand River, Mornington, Birregurra, Moorabool Valley, Camperdown, Airey's Inlet (Victoria).

Post-Eocene.—Table Cape (Tasmania).

Mr. G. B. Pritchard, Proc. Roy. Soc. Vict., 1896, p. 143, has reduced this species to a synonym with *M. compta* on the grounds that "there are so many gradations between them;" this is not my experience. The main distinctive characters of *M. compta* are the straight hinge-line and the tendency to biplication at the front.

FAMILY THECIDIIDÆ.

Genus Thecidium, *Defrance*, 1828.

T. australe, *Tate*, 1, p. 166.

Eocene.—Muddy Creek (Victoria).

FAMILY RHYNCHONELLIDÆ.

Genus Rhynchonella, *Fischer*, 1809.

R. Baileyana, Tate, 1885, quoted from the Miocene locality, Jemmy's Point, Gippsland Lakes, is not Australian. My surmise of its mesozoic origin is confirmed by Mr. R. Etheridge, jun., who attributes it to the Cretaceous of Faxoe.

R. squamosa, *Hutton; id. Tate*, 1, p. 166.

Eocene.—River Murray Cliffs, Aldinga Bay, and Muloowurtie, near Ardrossan (South Australia); Muddy Creek, Maude (*Hall* and *Pritchard*), Waurn Ponds near Geelong (Victoria); also New Zealand.

Post-Eocene.—Table Capə (Tasmania).

Rhynchonella (?) tubulifera, *spec. nov.* Pl. viii., figs. 4-4*a*.

Eocene.—Muddy Creek (Victoria).

Shell lenticular, suborbicular or transversely quadrate-oval in marginal outline; cardinal margin arched, anterior and posterior margins rounded, front margin nearly straight. Pedunculate valve depressedly convex; beak bluntly and shortly pointed, straight, and declinous from the hinge; foramen broadly triangular, large, margined by two suberect narrow-lanceolate deltidial pieces.

The ornament of the valves consists of rounded radial costæ, increasing in numbers by repeated bifurcation, forty or more slightly serrating the margin; there they are a little wider than the subconcave furrows. The ribs are surmounted by stout truncated tubular spines, sufficiently close together to be almost imbricating. Interior unknown.

Dimensions.—Length, 7·5; height (incl. beak), 6·75; sectional diameter, 2·5 mm.

One example obtained by Mr. J. Dennant from the polyzoal rock at Muddy Creek.

Observations.—I had considered this unique fossil to belong to

Terebratulina, and as a list name *T. tubulifera*, new sp., it appears in "Report Austral. Ass. Adv. Sc.," vol. II., p. 442, 1890, but the beak, foramen, and ornament suggest an affinity with *Rhynchonella squamosa*. Nevertheless, it presents externally certain resemblances to other genera, and its correct systematic position must be deferred till other specimens are discovered. Of *Rhynchonella squamosa* I have no juvenile specimens with which to make comparison; but the adult of it has usually not more than half the number of ribs. The tubular spines may be viewed as the result of fusion of the margins of vaulted scales, which are so characteristic of *R. squamosa*, but in this new species the concentric lamella do not pass across the furrows as in the other species; moreover *R. tubulifera*, if juvenile, is indicative of a much less gibbous shell in the adult stage.

FAMILY CRANIIDÆ.

GENUS CRANIA, *Retzius*, 1781.

C. quadrangularis, *Tate*, 1893, Proc. Roy. Soc., N.S. Wales, p. 191, t. 11, f, 12-12*a*.

EOCENE.—Muddy Creek, WAURN PONDS, and Maude (Victoria).
POST-EOCENE.—Table Cape (Tasmania).

INDEX TO PALLIOBRANCHIATA.

[The names of genera are printed in small capitals, those of valid species in Roman type, all synonyms in *Italic* type].

Gaulteri, Morris (*Terebratula*) is a Rhynchonella.
Grandis, Woods (Magellania).
Gravida, Suess (Magellania).
Gravida, Hutton=Magellania Vincentiana.
Imbricata, Woods=Magellania Garibaldiana.
Insolita, Tate (Magellania).
Johnstoniana, Tate (Magellania).
Lenticularis, Tate (Terebratulina).
Lucida (McCoy) Woods=Rhyn. squamosa.
Lunata, Tate (Magasella).
MacLeani, Tate (Magellania).
Macropora, McCoy=Magellania Garibaldiana.
MAGASELLA, Dall.
MAGELLANIA, Bayle.
Pectoralis, Tate (Magellania).
Pentagonalis, Tate (Terebratella).
Pumila, Tate (Terebratella).
Quadrangularis, Tate (Crania).
RHYNCHONELLA, Fischer.
Scoulari, Tate (Terebratulina).
Squamosa, Hutton (Rhynchonella).
Subcarnea, Tate (Terebratula).
Suessii, Hutton=Terebratulina Scoulari.
Sufflata, Tate (Magellania).
Tapirina, Hutton=Magellania insolita.
Tateana, Woods (Terebratula).
Tateana, Tate (Magellania).
Taylori, Etheridge (Magellania).
Tayloriana, Colenso=Magellania gravida.
Tenisoni, Woods (Magasella).
Tepperi, Tate (Terebratella).
TEREBRATELLA, D'Orbigny.
TEREBRATULA.
TEREBRATULINA, D'Orbigny.
THECIDIUM, Defrance.
Triangulare, Hutton (?)=Magellania sufflata.
Triangularis, Tate (Terebratulina).*
Tubulifera, Tate (Rhynchonella ?).
Vincentiana, Tate (Magellania).
Vitreoides, Tate=Terebratula Tateana.
Vitreoides, Woods (Terebratula).
Waldheimia, King=MAGELLANIA.
Woodsiana, Tate (Magasella).
Woodsii, Tate (Terebratella).

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* Has priority to *T. triangularis* [Eth.], Davidson, 1884=*Terebratula striata, var. triangularis*, Etheridge, 1881.

CLASS PTEROPODA.

Bibliographical References.

1. Tate, "Pteropods of the Older Tertiary of Australia," in Trans. Roy. Soc., S. Aust., vol. IX., 1887.
2. Harris, "Tertiary Mollusca of Australasia," British Museum Publication, 1897.

Genus Limacina, Lamarck, 1819.

Spiralis, Eydoux and Souleyet, 1840.

L. tertiaria, *Tate.*

Spiralis tertiaria, Tate, **1**, p. 196.
Limacina tertiaria, Harris, **2**, p. 19.
Eocene.—Muddy Creek and Mornington (Victoria).

Genus Styliola, *Lesueur*, 1825.

S. annulata, *Tate*, **1**, p. 195.
Eocene.—Adelaide-bore.

S. bicarinata, *Tate*, **1**, p. 195.
Eocene.—Muddy Creek, Victoria.

S. Rangiana, *Tate.* **1**, p. 194.

Clio (Styliola) Rangiana, Harris, **2**, p. 20.
Eocene.—Muddy Creek and Mornington.

Genus Vaginella, *Daudin*, 1800.

V. eligmostoma, *Tate*, **1**, p. 195 : *id.*, *Harris*, **2**, p. 21.

Mr. Harris gives the result of a comparison of the specimens of this species and *V. depressa* of the Bordeaux basin, a resemblance that I had noted, which justifies the retention of *V. eligmostoma* for the Australian fossil.

Eocene.—Muddy Creek, Gelibrand River, and Mornington (Victoria).

Genus Hyalea, *Lamarck*, 1799.

Hyalea, *sp.*

Eocene at Mornington.

As yet only one example is known to me, but most unfortunately it broke to pieces on immersion in water to free it from the clayey-matrix, and before I had investigated its specific relationships.

CLASS SCAPHOPODA.

Bibliographical References.

1. Tate, "Scaphopods of the Older Tertiary of Australia," in Trans. Roy. Soc., S. Aust., vol IX, 1887.
2. Harris, "Tertiary Mollusca of Australasia," British Museum Publication, 1897.
3. Sharp and Pilsbry, in "Tryon's Manual Conchology," vol. XVII., 1898.

FAMILY DENTALIIDÆ.

The characters, viz., the presence or absence of an apical slit or notch or of an apical plug, which have been utilised for the genera of the family, have lately been shown to be more or less adventitious, and, therefore, they can be employed only for mere classificatory convenience ; hence *Entalis*, as previously employed by me in a generic sense, merges into *Dentalium*. However, I adopt Pilsbry's arrangement of the groups, though I degrade his subgenera to sections, as a convenient method of contrasting our species.

Genus Dentalium, *Linnæus*.

Section Dentalium (*sensu stricto*).

Shell longitudinally ribbed at least posteriorly, apex without slit or notch.

This group is unrepresented in the Older Tertiaries, unless *D. bifrons* should eventually prove to be without an apical slit or fissure.

Section Fissidentalium, *Fischer*, 1885.

Shell longitudinally ribbed at least near the apex, a long apical slit.

D. bifrons, *Tate*, 1, p. 192 ; *id.*, *Harris*, 2, p. 295.

Post-Eocene.—Spring Creek (Victoria).

Miocene.—Muddy Creek (Victoria).

The apex is still unknown, and therefore the location of the species in this section or in the foregoing is uncertain.

D. Mantelli, *Zittel*, 1864 ; *id.*, *Tate*, 1, p. 190 ; *id.*, *Harris*, 2, p. 293.

Eocene.—River Murray Cliffs and Aldinga Bay (S. Aust.) ; Bellarine Pen. (Hall and P.), Muddy Creek, Gelibrand River, Mornington, Corio Bay, Birregurra, Moorabool Valley, Camperdown, Shelford, Cape Otway (Victoria) ; also New Zealand.

Post-Eocene.—Table Cape (Tasmania), and Spring Creek (Victoria.)

I am now able to pronounce on the specific distinction of *D. Mantelli* and *D. Kickxi*, Nyst (authentic examples of the latter from the Miocene at Boom, Belgium, I have under observation). Tasmanian examples of *D. Mantelli* were referred by Tenison-Woods to the Belgian species. I do not know to what group *D. Kickxi* belongs, but apart from any apical differ-

ences, *D. Mantelli* enlarges more rapidly, and the costation is acute, elevated, and regularly disposed, primary and secondary costæ alternating; in *D. Kickxi* the costations are broad, depressed, and irregularly disposed, anteriorly they are more numerous than in the Australian species.

D. latesuclatum, *spec. nov.* Pl. viii., fig. 9.

Shell nearly straight, nine-angled (rarely twelve-angled) of rapid increase, being about seven times as long as wide. Surface ornamented with nine (rarely twelve), strong, elevated ridges, which are somewhat compressed at the sides and roundly truncated atop; the ridges are somewhat irregularly disposed being closer together on the convex aspect and fewer on the concave aspect, they extend from the apex in undiminished strength to the oral aperture; the concave furrows at the apex are of about equal width with the ridges, thence they increase in breadth till at the oral aperture they are on the convex aspect from two to three times as wide as the ridges, and as much as four times on the concave aspect. The interstitial furrows in the basal portion may have a few longitudinal threads and striæ, and are traversed by sub-distant incremental lines which pass over the costæ.

Apex truncated with a long narrow slit on the convex face, no plug; the aperture is circular internally, polygonal externally; oral aperture with a thin acute margin (thus indicating a perfect shell) of a polygonal outline.

Length, 40; breadth of oral aperture, 6—7 mill.

Miocene.—In the basal clay-bed at Grange Burn near Hamilton, Victoria (nine examples).

Among species of the same section having a prominent polygonal transverse section the Grangeburn fossil makes a closer agreement with *D. striatum*, Lamarck, as figured by Deshayes, Mon. Dentale, than with any other, but it is abbreviated in length and is broader, has nine ridges, not twelve to fourteen. There are, however, some species in Section Dentalium (restricted) which offer some similitude, such as *elephantinum*, *aprinum*, &c. It is not likely to be mistaken for *D. Mantelli* with its numerous and slender ribs, which are evanscent at the anterior one-third or thereabouts.

Section Graptacme, *Pilsbry* and *Sharp*, 1897.

Surface sculptured with close, fine, deeply engraved, longitudinal striæ near the apex.

D. sectiforme, *spec. nov.* Pl. viii., figs. 6-6*a*

Shell small, very slender, very little tapering, slightly arched, translucent-white and shining. Sculpture of very numerous,

close, subequal riblets extending longitudinally from apex for about three-fourths of total length of shell. The riblets become faint at about half the total length, where appears fine annular sculpture; the anterior one-fourth with fine annular sculpture. Aperture circular with an acute peristome. Apex with a straight, short, narrow slit on the convex side; apical orifice contracted by a plug deeply and widely cleft from the convex to the concave side,

Length of shell, 11 to 13; diameter of aperture, 1; height of arch from chord, 1·25 mm.

Miocene.—Muddy Creek (Victoria).

In Pilsbry's arrangement of the recent Dentaliums, this fossil species falls in the "Group of *D. sectum*" of the Section Graptacme. In slenderness and curvature it approximates to the two species including in the group, nearer to *calamus* than to *sectum* by the longitudinal striæ extending nearly to the aperture; from both it is distinguished by the prominent annular sculpture of the anterior portion of the tube.

Section Lævidentalium, *Cossmann*, 1888.

Shell smooth with annular growth lines.

a. Apex with a short slit or triangular notch.

D. subfissura, *Tate*, 1, p. 191; *id.*, *Harris*, 2, p. 296.

Apical fissure a short triangular notch with a plug in the type example.

Eocene.—River Murray Cliffs and Aldinga Bay (S. Aust.); Bellarine Pen. (Hall and P.), Muddy Creek, Gelibrand River, Mornington, Corio Bay, Belmont, Camperdown, Shelford, Maude, Cape Otway (Victoria).

Post-Eocene.—Spring Creek (Victoria).

Dentalium pictile, *spec. nov.* Pl. viii., fig. 8.

Shell slender, about thirteen times as long as wide, much arched, smooth, without any trace of striæ, dark coloured with lighter-coloured oblique bands. Apex about one millimetre in the lateral diameter, slightly less in the concavo-convex diameter, with a short and broad notch on the convex side; there are traces of a plug.

Length, 52; breadth of oral aperture, 4; height of arch from chord, 6 mills.

Post-Eocene.—Table (Cape Tasmania).

Previously listed by Tate and Dennant, Correlation Papers, III., 1896, as *D. subfissura.* I separate this species from *D. subfissura*, because of its greater curvature, not so slender at the apex, which is elliptic, and not circular in sectional outline.

D. largiercscens, *spec. nov.* Pl. viii., figs. 10-10*a*.

Shell smooth and shining, considerably arched, six and a-half times as long as wide, rapidly increasing; sculptured with distinct, oblique, incremental lines; apical fissure a short slit or triangular notch on the convex side, no plug; anterior extremity circular.

Length, 44; diameter of anterior extremity, 6·5; at apex, 1; height of arch above the chord, 2 mills.

This new species resembles *D. subfissura*, from which it differs by stronger curvature, by rapid increase, not so attenuated apically, and by the obliquely annular sculpture. The rapid increase in diameter and the strong curvature distinguish it also from recent species.

Post-Eocene.—Beaumaris (six exs.).

Miocene.—Junction-bed, Grange Burn (one ex.); Gippsland Lakes (one ex., J. Dennant).

b. Apex simple, without notch or slit.

D. lacteolum, *spec. nov.*

D. lacteum, Tate, 1, p. 193, non Deshayes.

A reference to the full description and ample illustrations of *D. lacteum*, Deshayes, in Pilsbry's monograph of the genus, satisfies me that this recent species is not present in our Older Tertiaries. The transverse section of both is circular, but the rate of increase of the sectional diameter is not the same; thus in *D. lacteum*, with a total length of 30 mm., the diameter is 2·5, whilst in the fossil species for a length of 35 mm. the diameter is 2·25 (vix); hence *D. lacteolum* is a more slender shell. It is straighter and more slender than the posterior part of *D. subfissura*, and is therefore somewht similar to *D. acriculum*, from both distinguished, of course, by the absence of an apical notch.

Tenison-Woods recorded *D. lacteum (?)* as a Table Cape fossil, but the only *Lœvidentalium* at that locality, so far as known from my own and other collections, is *D. pictile*, which I am disposed to regard as the shell observed by him.

Eocene.—Muddy Creek and Gelibrand River, Victoria.

Section Fustiaria, *Stoliczka*, 1868.

Shell smooth, or with annnlar sculpture; slit long.

D. acriculum, *Tate*, 1, p. 192; *id.*, *Harris*, 2, p. 296.

Shell curved, slender, smooth.

Eocene.—Muddy Creek, Victoria.

D. australe, *Sharp* and *Pilsbry*, 3, p. 192.

Entalis annulatum, Tate, 1, p. 191. Name preoccupied by Gmelin, by Sandberger, and by Meyer.

Shell large, nearly straight, with annular lines.

Eocene.—Muddy Creek and Shelford, Vict.

Post-Eocene.—Spring Creek, Vict.

A variant of this species occurs at Spring Creek, which is usually more slender, the length to the breadth being 12 to 1, as against 10 to 1; and in one individual the apical slit is 18 millimetres.

Section Episiphon, *Pilsbry* and *Sharp*, 1899.

Apex entire with a projecting tube.

a. Shell longitudinally ribbed.

D. aratum, *Tate*, 1, p. 192; *id.*, *Harris*, 2, p. 293.

This species has a truncated apex of about one millimetre diameter from the orifice of which protrudes a very short, smooth subpellucid tube. The truncated end is of a white ceramic lustre and is concentrically striate; the whole appearances suggest that the embryonic and attenuated tip has been cast off. *D. aratum* differs from all congeners in the group by its longitudinal ornament and sculpture.

Eocene.—River Murray Cliffs and Muloowurtie, S. Aust.; Bellarine Pen. (Hall and Pritchard), Muddy Creek, Gelibrand River, Fyansford, Birregurra, Mornington, Camperdown, Cape Otway (Victoria).

Post-Eocene.—Spring Creek.

b. Shell with annular ridges.

D. tornatissimum, *spec. nov.* Pl. viii., figs. 7-7*a*.

Shell very small, nearly straight; sculptured with annular rounded ridges, more or less regular throughout the whole length (here and there a stouter annulation of about double breadth), wider than the deep narrow intervening grooves, ten in a millimetre length of the apical part.

Test very thick. Apex simple, circular, truncate; projecting from the aperture is a round pipe about ·16 in diameter and ·2 mm. long. Anterior extremity not known; all the specimens present the appearance of being fragments of larger individuals; however, the transverse section is circular.

Length 7, diameter at aperture ·9, at apex ·55 mill.

Miocene.—Gippsland Lakes (4 exs., J. Dennant).

This species is closely related to *D. tornatum*, Watson, dredged off Levuka in 12 fms. (Challenger Exped.), which is distinguished from other components of Pilsbry and Sharp's subgenus *Episiphon* by its annular grooves. *D. tornatum* is described as possessing deep, close-set, slightly oblique, annular grooves in the upper part of the shell only, becoming shallower further down and cease at last rather abruptly. The fossil analogue has the

grooves, not at all oblique or very slightly so, equally strong at the anterior as at the posterior extremity, but on the other hand the fossil is, so far as known, only about half the length of the living species. I am afraid comparison of actual specimens can only decide if there be differences in the number of the annulations for equal units of length, as the figures and description by Watson do not afford a sufficiency of detail on this head. Nevertheless, it is stated that the flat bands are of variable widths, and increase with the growth of the shell from about 0·011 inch to twice that amount, a description that does not apply to the fossil; and, moreover, the test is so thick that translucency can hardly have belonged to it.

SECTION GADILINA, *Forresti*, 1895.

Apex entire, shell subtriangular in section.

D. Tatei, *Sharp* and *Pilsbry*, 3, p. 218 (*nom. mutand.*).
D. triquetrum, Tate, 1, p. 193; non Brocchi, 1814.
EOCENE.—ADELAIDE-BORE.

FAMILY SIPHODENTALIIDÆ.

GENUS CADULUS, *Philippi*, 1844.

C. mucronatus, *Tate*, 1, p. 193; *id.*, *Harris*, 2, p. 297.
EOCENE.—MUDDY CREEK (Victoria).
POST-EOCENE.—Spring Creek (Victoria).

SECTION GADILA, *Gray*, 1847.

C. acuminatus, *Tate*, 1, p. 194; *id.*, *Pilsbry*, 3, p. 183, t. 32, figs. 47-49.
MIOCENE.—Aldinga Bay (S. Aust.)
RECENT.—SOUTH AUSTRALIA and N. S. Wales.

Mr. Pilsbry, *op. cit.*, very justly remarks that the species name is inappropriate, though it is appropriate as applied to the perfect shell. It happens that the apical half or so is deciduous, and certainly the decollated portion, which is the part generally known, cannot be called acuminate. As regards this interesting phase of the Cadulus-shell, I leave to Dr. Verco to make more fully known, as the material in his possession is more thoroughly illustrative than what I possess.

However, I borrowed the name after Deshayes, who, on the authority of Angas, had so attached his MS. name to New South Wales specimens in the British Museum, and Angas so listed the species for South Australia on the testimony of examples forwarded by me. (Proc. Zool. Soc., 1878, p. 868).

C. infans, *spec. nov.* Pl. viii., fig. 11.

Similar to *C. acuminatus* (Pl. viii., fig. 12), though words can hardly convey those differences which the eye can appreciate. The shell

is slightly swollen in the anterior one-third on the convex side, thence gradually tapering to each end; the convex side is not so arched as in *C. acuminatus*, whilst in contrast with *C. infans*, in which the shell tapers from its greatest diameter, the shell of *C. acuminatus* has an almost uniform diameter throughout, until very near the extremities a slight decrease in diameter is observable. Apertures circular and their margins acute.

Length.—3·2 mills.

Miocene.—Muddy Creek (one ex.).

Index to Scaphopoda.

[The names of genera or subgenera are printed in small caps; those of valid species in Roman type; all synonyms in italic type.]

EXPLANATION OF PLATE VIII.

CLASS LAMELLIBRANCHIATA.

Bibliographical References.

1. Tate, "Lamellibranchs of the Older Tertiary of Australia," Part I., in Trans. Roy. Soc., S. Aust., vol. VIII., 1886.
2. Tate, *id.*, Part II., *op. cit.*, vol. IX., 1887.
3. Tate, "Unrecorded Genera of the Older Tertiary Fauna of Australia," Journ. Roy. Soc., N.S. Wales, vol. XXVII., 1894.
4. Harris, "Tertiary Mollusca of Australia," British Museum Publication, 1897.

FAMILY OSTREIDÆ.

Genus Ostrea, *Linnaeus*, 1758.

O. arenicola, *Tate*, **1,** p. 97; *Harris*, **4,** p. 300.

Miocene.—*Aldinga Bay*, Murray Cliffs (S. Aust.); Gippsland Lakes and Shelford (Vict.), doubtful identifications.

O. hyotidoidea, *spec. nov.*

O. hyotis, Tate, **1**, p. 96, pl. vi., fig. 5; Harris, **4**, p. 229; non Linnaeus.

Now that I have examples of *O. hyotis* for comparison with the fossil oyster of our Eocene beds, which I had tentatively referred to that living species, I am induced to regard the two as distinct. The fossil species is more depressed, more irregular in outline; the radial ridges less elevated and obtuse, whilst the foliaceous scales very rarely develop into tubular spines; at the same time its restriction to Eocene strata implies specific distinction.

Eocene.—*River Murray Cliffs* and Aldinga Bay (S. Aust.); Muddy Creek, Mornington, Moorabool Valley (*Hall* and *Pritchard*), and Shelford (Vict.).

Post-Eocene.—Table Cape (Tasm.).

O. manubriata, *Tate*, **2,** p. 184; *Harris*, **4,** p. 300.

Miocene.—*Muddy Creek* (Vict.).

O. Sturtiana, *Tate*, **1,** p. 97; *Harris*, **4**, p. 299.

Miocene—*River Murray Cliffs* (S. Aust.).

EXCLUDED SPECIES.

O. hippopus, Tate, **1**, p. 98, name preoccupied by Lamarck, 1818, is, I think, an individual monstrosity of *Gryphæa tarda.*

Subgenus Gryphæa, *Lamarck*, 1801.

G. tarda, *Hutton*, 1873; *id.*, *Tate*, **1,** p. 98; *Harris*, **4,** p. 302.

Ostrea hippopus, Tate, 1886.

Eocene.—Aldinga Bay, Witton Bluff, Chalk-cliffs of the *Great Bight* (S. Aust.); Muddy Creek, Cape Otway, Shelford (Vict.); also New Zealand.

Post-Eocene.—Spring Creek (identification doubtful).

FAMILY DIMYIIDÆ.

GENUS DIMYA, *Rouault*, 1850.

D. dissimilis, *Tate*, **1,** p. 100; *Harris*, **4,** p. 306.

EOCENE.—R. Murray Cliffs, Aldinga Bay, Muddy Creek, Gelibrand River, Mornington, Birregurra, Corio Bay, Moorabool Valley and Bellarine Peninsula (*Hall* and *Pritchard*), Camperdown, Shelford, Cape Otway, Maude.

POST-EOCENE.—Beaumaris and Spring Creek (Vict.); Table Cape (Tasm.).

D. sigillata, *Tate*, **1,** p. 100; *Harris*, **4,** p. 306.

EOCENE.—*Aldinga Bay* (Turritella-marls).

FAMILY ANOMIIDÆ.

GENUS PLACUNANOMIA, *Broderip*, 1832.

P. Ione, *Gray; id.*, *Tate*, **1,** p. 101; *Harris*, **4,** p. 303.

EOCENE.—Fyansford and Muddy Creek, doubtful identifications; Corio Bay.

POST-EOCENE.—Spring Creek (Vict.).

MIOCENE.—Aldinga Bay and River Murray Cliffs (S. Aust.); Muddy Creek and Gippsland Lakes (Vict.).

RECENT.—S. Australia, Tasmania, and New Zealand.

P. sella, *Tate*, **1,** p. 102; *Harris*, **4,** p. 304.

EOCENE.—*R. Murray Cliffs* (S. Aust.); Muddy Creek, Mornington, and Shelford, Waurn Ponds (*Hall* and *Pritchard*); also New Zealand.

POST-EOCENE.—Spring Creek (Vict.); Table Cape (Tasmania).

GENUS ANOMIA, *Linnæus*, 1758.

A. (?) cymbula, *Tate*, **1,** p. 101.

EOCENE.—*Aldinga Bay* (Glauconitic limestone).

FAMILY PECTINIDÆ.

GENUS PECTEN, *Muller*, 1776.

P. antiaustralis, *Tate*, **1,** p. 106; *Harris*, **4,** p. 315.

MIOCENE.—*Adelaide*, Aldinga Bay, and Edithburg (S.A.); Muddy Creek, Gippsland Lakes, and Shelford (V.).

P. consobrinus, *Tate*, **1,** p. 104; *Harris*, **4,** p. 317.

MIOCENE.—*Aldinga Bay.*

——— var.

EOCENE.—Aldinga Bay, Shelford, Maude and Belmont, Waurn Ponds (Hall and Pritchard).

POST-EOCENE.—Spring Creek.

P. palmipes, *Tate*, **1,** p. 105; *Harris*, **4,** p. 318.

MIOCENE.—*Aldinga Bay* and Edithburg (S. Aust.).

P. subbifrons, *Tate*, 1882; *id.*, **1**, p. 104.

Eocene.—Aldinga Bay and Shelford, Waurn Ponds (Hall and Pritchard).

Miocene.—Aldinga Bay, *Adelaide* (S.A.).

P. subconvexus, *Tate*, **2**, p. 185.

Miocene.—*Muddy Creek*, but possibly derived from Eocene.

P. Aldingensis, *Tate*, **1**, p. 109.

Eocene.—*Aldinga Bay* and Stansbury (S. Aust.).

P. dichotomalis, *Tate*, **1**, p. 106.

Eocene.—Bellarine Pen. (*Hall* and *Pritchard*), *Mornington*, Gelibrand River (Vict.).

P. Eyrei, *Tate*, **1**, p. 107; *Harris*, **4**, p. 318.

Eocene.—*Aldinga Bay* (S. Aust.); Moorabool Valley and Maude (*Hall* and *Pritchard*) (Vict.).

P. Flindersi, *Tate*, **1**, p. 108.

Eocene.—*Aldinga Bay* and Muloowurtie near Ardrossan (S.A.).

P. Foulcheri, *Woods*, 1865; *id.*, *Tate*, **1**, p. 111.

Eocene.—R. Murray Cliffs and *Mount Gambier* (S.A.); Bellarine Pen. and Maude (*Hall* and *Pritchard*). Muddy Creek, Mornington, Moorabool Valley, Cape Otway, Shelford (V.).

Post-Eocene.—Spring Creek (V.); Table Cape (T.).

P. Gambierensis, *Woods*, 1865; *id.*, *Tate*, **1**, p. 112.

Eocene.—*Mount Gambier* (S.A.); Moorabool Valley (Hall and Pritchard), (V.).

Post-Eocene.—Spring Creek near Geelong (V.).

P. Murrayensis, *Tate*, **1**, p. 105; *Harris*, **4**, p. 314.

Eocene.—*R. Murray Cliffs* (S.A.); Muddy Creek, Moorabool Valley, Shelford (Vict.).

Post-Eocene.—Spring Creek (V.).

P. Peroni, *Tate*, **1**, p. 108; *Harris*, **4**, p. 317.

Eocene.—*Aldinga Bay* (S.A.); Waurn Ponds (*Hall* and *Pritchard*), Western Beach, Corio Bay (V.).

P. polymorphoides, *Zittel*, 1864; *id.*, *Tate*, **1**, p. 113; *Harris*, **4**, p. 316.

Eocene.—River Murray Cliffs (S.A.); Muddy Creek, Gelibrand River, and Shelford, Waurn Ponds (*Hall* and *Pritchard*), (V.); also *New Zealand*.

Post-Eocene.—Spring Creek (V.).

P. Sturtianus, *Tate*, **1**, p. 109; *Harris*, **4**, p. 315.

Eocene.—*River Murray Cliffs* (S.A.); Waurn Ponds (*Hall* and *Pritchard*), Muddy Creek, Bairnsdale, Shelford (V.).

Post-Eocene.—Spring Creek.

Miocene.—Muddy Creek (probably derived).

P. Meringæ, *spec. nov.**

MIOCENE.—*Gippsland Lakes* (V.).

Shell suborbicular in marginal outline, equilateral, inequivalve, radially ribbed, ribs in five groups, ears large.

Right valve of about 50 mm. diameter, moderately inflated, ventral margin undulating corresponding with the areas occupied by the five groups of primary radial ribs and their intervening concave furrows. Primary ribs stout, flatly convex, with precipitous sides, about 18, variously grouped in twos, threes, and fives, forming elevated radial folds; the intervening concave areas with one or two slender ribs; the whole surface covered with close-set, slender, undulating, concentric liræ, more or less lamellose on the primary ribs (ten in a length of one mm. at the front on the medial line). Anterior ear large, falcate, with three or four radial riblets, crossed by concentric liræ forming slight squamæ on the riblets and terminating in a serrated crest on the dorsal margin. Posterior ear of less size, right-angled triangular, ornamented with fine concentric liræ.

Left valve flat, the ornament similar to, but alternating with, that of the inflated valve; the anterior ear has, however, stouter riblets, and the transverse liræ rise into erect lamelliform scales.

An adult left valve of 95 mm. diameter has five broad elevated rays, the ribs of which are finally evanescent, whilst the riblets in the interstitial furrows are not so pronounced as in the medium-sized valves.

Dimensions of the figured shell.—Antero-posterior diameter, 40; ventro-dorsal diameter, 35; thickness through both valves, 10 mm.

The name of the species perpetuates that of an aboriginal locality whence the fossils have chiefly been obtained.

This species is separated from the *bifrons*-group by the absence of shagreen sculpture; the clustering of the ribs into sets allies it to *polymorphoides* among our fossil forms, and to *undulatus* and related species among living species of the *Janira*-group. It differs from *polymorphoides*, its nearest ally, by the regular convexity of the inflated valve, and by the distinct equilaterality of the shell.

SPECIES EXCLUDED.

P. spondyloides, Tate, 1886=SPONDYLUS ARENICOLA.

P. deformis, Tate, 1887, is a worn HINNITES CORIOENSIS.

SECTION PSEUDAMUSSIUM, *H.* and *A. Adams*, 1855.

Surface smooth, no internal ribs.

* The illustrations of this and other species diagnosed in the following pages are deferred to the issue of the concluding part of the "Revision of the Lamellibranchiata."

P. Hochstetteri, *Zittel*, (*sp.*), 1861 ; *id.*, *Tate*, **1**, p. 114.

P. (*Pseudamussium*) *Hochstetteri*, Tate, P.R. Soc., N.S.W., vol. XXXI., p. 408, 1898.

Eocene.—River Murray Cliffs, Mount Gambier, Aldinga Bay, Adelaide-bore, Stansbury, and Muloowurtie (South Australia) ; Muddy Creek, Shelford, Camperdown, and Airey's Inlet (Victoria) ; also *New Zealand.*

Post-Eocene.—Spring Creek, Vic.; Table Cape, Tas.

Section Propeamussium, *DeGregorio*, 1883.

Valves with dissimilar ornament, smooth or radially striate, no internal ribs.

P. Yahlensis, *Woods* (*sp.*), 1865 ; *id.*, *Tate* **1**, p. 110.

Pseudamussium Yahlensis, Harris, **4**, p. 322.

P. (Pseudamussium) Yahlensis, Tate, P.R. Soc., N.S.W., vol. XXXI., p. 408, 1898.

Pecten Hectori, Hutton, Cat. Test. Moll., N.Z., p. 30, 1873.

Eocene.—River Murray Cliffs and *Mount Gambier* (S.A.) ; Bellarine Pen. and Moorabool Valley (*Hall* and *Pritchard*), Corio Bay, Muddy Creek. Gelibrand River, Mornington, and Bairnsdale (Victoria) ; also New Zealand.

Post-Eocene.—Beaumaris, Vic.; Table Cape, Tas.

Genus Amussium, *Megerle*, 1811.

Valves with dissimilar ornament.

A. Zitteli, *Hutton* (*sp.*), 1873 ; *id*, *Tate*, **1**, p. 115 ; *Harris*, **4**, p. 324.

Eocene.—River Murray Cliffs, Aldinga Bay, and Mount Gambier (S.A.) ; Bellarine Pen. (*Hall* and *Pritchard*), Muddy Creek, Gelibrand River, Mornington, Fyansford, and Cape Otway (Victoria) ; also *New Zealand.*

Post-Eocene.—Table Cape, Tasmania.

Section Pleuronectia, *Swainson*, 1840.

Valves smooth.

A. lucens, *Tate*, **1**, p. 115.

Post-Eocene.—Spring Creek, Victoria.

Miocene.—*Aldinga Bay*, S. Australia.

Genus Hinnites, *Defrance.*

H. Corioensis, *McCoy*, 1879 ; *id.*, *Tate*, **1**, p. 116.

H. trailli, Hutton, Cat. Tert. Moll., N.Z., p. 32, 1873. *Pecten deformis*, Tate, **2**, p. 185.

Hutton's diagnosis contains no specific characters, and the name should be regarded as invalid.

Eocene.—Waurn Ponds, Moorabool Valley and Maude (*Hall* and *Pritchard*), Muddy Creek, *Corio Bay*, Bairnsdale (V.) ; River Murray Cliffs (S.A.) ; also N.Z. (Pareora Formation).

Post-Eocene.—Table Cape (T.).

The valve on which was founded *P. deformis*, and recorded as Miocene, has all the appearance of a derived origin.

FAMILY LIMIDÆ.

Genus Lima, *Lamarck*, 1789.

L. Bassii, *Woods*, 1877; *id.*, *Tate*, **1**, p. 117; *Harris*, **4**, p. 310.

Eocene.—River Murray Cliffs, Aldinga Bay, Adelaide-bore (S.A.); Bellarine Pen. (*H.* and *P.*), Muddy Creek, Gelibrand River, Mornington, Belmont, Cape Otway, Maude, Shelford (V.); also N.Z.

Post-Eocene.—*Table Cape* (Tasmania).

L. linguliformis, *Tate*, **1**, p. 118; *Harris*, **4**, p. 310.

Eocene.—Belmont (*H.* and *P.*), *Muddy Creek*, Mornington (V.).

Post-Eocene.—Table Cape (Tasmania).

L. polyactina, *Tate*, **1**, p. 118.

Eocene.—*Adelaide-bore.*

Section Limatula, *S. Wood*, 1839.

L. Jeffreysiana, *Tate*, 1884; *id.*, **1**, p. 119; *Harris*, **4**, p. 311.

Lima bullata [Born], Hutton, Cat. Tert. Moll., N.Z., p. 33, 1873; non Born.

Eocene.—River Murray Cliffs, Aldinga Bay, Mount Gambier (S.A.); Waurn Ponds (*H.* and *P.*); Muddy Creek, Mornington, Shelford (V.); also New Zealand [Oamaru Formation].

Post-Eocene.—Spring Creek (V.); *Table Cape* (T.).

Miocene.—Edithburg, Aldinga Bay, River Murray Cliffs (S.A.); Muddy Creek (V.).

L. subnodulosa, *spec. nov.*

Test stout; shell inflated, slightly inequilateral (the posterior side being a little protuberant in the middle line). Ornamented with 25 stout, rounded ribs, which are somewhat nodulose anteriorly; the narrower interstices are crossed by moderately stout threadlets.

This species has the aspect of a *Limea*, but there are no traces of teeth.

Dimensions.—Umbo-ventral diameter, 4·5; antero-dorsal diameter, 3·5; height of valve, 1·75 mm.

Miocene.—Muddy Creek, Victoria (one ex.). The shell is somewhat polished, evidently by erosion, and may have been derived from the underlying Eocene.

L. polynema, *Tate*, **1**, p. 119.

Eocene.—Adelaide-bore.

L. crebresquamata, *spec. nov.*

Shell considerably inflated with a prominent umbo which arches over the hinge-line. Hinge-line straight, narrow, the shell widening thence to about two-thirds of the total length, thence slightly narrowing to the arched front.

Radial ribs about 50, subacute, beset with suberect squamæ which are sometimes denticuliform; they extend down the sides of the ribs, but do not cross the furrows; the squamæ are close-set, and often subimbricate. The furrows are not so wide as the ribs, and appear to be inornate.

Dimensions.—Umbo-ventral diameter, 12; antero-posterior diameter, 8; length of hinge-line, 4; thickness through both valves, 10 mm.

Post-Eocene.—Spring Creek, Vict. (three examples).

Genus Limea, *Brown*, 1831.

L. alticostata, *Tate*, **1**, p. 119.

Eocene.—Adelaide-bore.

L. transenna, *Tate*, **1**, p. 119; *id. Harris*, **4**, p. 313.

Eocene.—Mount Gambier, S.A.; Bellarine Pen. (*Hall* and *Pritchard*), *Muddy Creek*, Mornington, and Shelford (Victoria).

Post-Eocene.—Table Cape, Tasmania.

L. multiradiata, *spec. nov.*

Shell moderately inflated with a pointed central umbo; subinequilateral, the umbo-ventral axis slightly oblique; wings slightly developed. The surface of the valves ornamented with numerous flatly-rounded smooth ribs (about ten to one mm. of width in the medial area), separated by flat, equally wide or slightly wider furrows; the furrows are ornamented by transverse, close-set, slender threadlets.

There are six teeth on each half of the hinge-line and its decurrent portions on the anterior and posterior side; those nearest the ligamental pit are oblique, the others are somewhat transverse.

Dimensions.—Length of hinge, 2; umbo-ventral diam., 5·25; antero-posterior diam., 5 mm.

Eocene.—"Turritella-marls," Aldinga Bay (six exs.).

This species resembles *L. transenna*, but has not the marked obliquity of that shell, and, moreover, the ribs are more numerous, with narrower interstitial furrows, and the transverse threadlets are finer and closer together.

FAMLY SPONDYLIIDÆ.

GENUS SPONDYLUS, *Linnaeus*, 1758.

S. gaderopoides, *McCoy*, 1876; *id.*, *Tate*, **1**, p. 121; *Harris*, **4**, p. 307.

EOCENE.—Aldinga Bay (Glauconitic limestone), Yorke-Peninsula, chalk-cliffs of the Great Bight (S.A.); Maude (*H.* and *P.*), Gelibrand River, Bairnsdale (V.).

POST-EOCENE.—Spring Creek (V.); Table Cape (T.).

S. pseudoradula, *McCoy*, 1877; *id.*, *Tate*, **1**, p. 121; *Harris*, **4**, p. 308.

EOCENE.—River Murray Cliffs (S.A.); Bellarine Pen. (*H.* and *P.*), Muddy Creek, Gelibrand River, Mornington, Moorabool Valley, Shelford, Bairnsdale (V.).

POST-EOCENE.—Beaumaris (V.); Table Cape (T.).

S. arenicola, *Tate*, Aust. Assoc. Adv. Sc., vol. VI., 1896, p. 318.

Pecten spondyloides, Tate, 1, p. 19, t. 4, fig. 6, non fig. 7.

Spondylus Aldingensis, Tate, 1896, T. Roy. Soc., S.A., vol. XX., p. 121.

MIOCENE.—*Aldinga Bay* (S.A).

Pecten spondyloides having been ascertained to have all the interior characters proper to *Spondylus*, it seemed necessary to change the specific name, as *Spondylus spondyloides* is hardly a binomial form, hence the names *arenicola*, *Aldingensis*. These two names were applied about the same time, though the first appeared earlier in print, and a lapse of memory is the sole reason for using the latter.

S. Murravicus, *Tate*, 1899.

Pecten spondyloides, var., Tate, 1, t. 4, fig. 7.

EOCENE.—River Murray Cliffs at *Mannum*, S.A.

GENUS PLICATULA, *Lamarck*.

P. ramulosa, *Tate*, 1898, Proc. Roy. Soc., N.S.W., vol. XXXI., p. 408, t. 19, fig. 3.

POST-EOCENE.—*Table Cape* (Tasmania).

FAMILY PTERIIDÆ.

GENUS PTERIA, *Scopoli*, 1777.

[*Avicula*, Bruguière; adopted from Klein, 1753, a pre-Linnæan name.]

P. nasuta, *Tate*, **1**, p. 121.

EOCENE.—*Adelaide-bore*.

GENUS MARGARITIFERA, *Brown*, 1789.

Meleagrina, Lamarck, 1812.

M. crassicardia, *Tate*, **1**, p. 121; *Harris*, **4**, p. 325.

Eocene.—R. Murray and Muddy Creek.
Miocene.—*River Murray Cliffs* (S.A.).
Older Pliocene.—Dry Creek-bore, near Adelaide.

Genus Vulsella, *Lamarck*, 1799.

V. lævigata, *Tate*, **1**, p. 122]; *Harris*, **4**, p. 326.

Eocene.—*Aldinga Bay* (Glauconitic 'imestone).

Genus Melina, *Retzius*, 1781.

[*Perna*, Bruguière, 1792.]

M. sp., *Tate*, 1886.

Eocene.—Aldinga Bay (S.A.); also Oamaru formation, New Zealand. From both localities known only as casts.

Melina percrassa, *spec. nov.*

Shell oblong-cuneate, somewhat oblique, equivalved, not winged; test very thick and perlaceous.

Hinge line, inner margin straight, outer-margin convex; deepest anteriorly (22 mm.), eight to nine moderately deep ligamental furrows, marked by arched transverse striæ, two millimetres, more or less, in width, slightly narrower than the interstitial concave areas.

Anterior margin slightly incurved at the summit of the byssal sinus (the left valve has a slight expansion superiorly), slightly convex in alignment with byssal sinus, thence roundly sloping to the ventral margin, which is narrowly rounded; posterior margin with a slight outward-curving slope. The byssal sinus is in the left valve, very long (30 mm.) and narrow (2 mm. at its widest).

Surface of valves marked by the somewhat crowded edges of imbricating lamellæ.

Dimensions.—Hinge line, 42 mm. long; umbo-post-ventral diameter, 80; sectional diameter, 32 mm.; greatest thickness of test, 15.

Habitat.—Junction-bed of the Miocene at Grangeburn, near Hamilton, Victoria (two pairs of valves in apposition).

This species offers no distinctive features, except perhaps in respect of its convex dorsal margin and its excessively thick test, which, after all, may only be the result of extreme age. It has some analogy with *P. Lamarcki* of the Parisian Eocene.

FAMILY PINNIIDÆ.

Genus Pinna, *Linnæus*, 1758.

P. semicostata, *Tate*, **1**, p. 122.

Miocene.—*Aldinga Bay* (S.A.).

P. cordata, *Pritchard*, 1895, Proc. Roy. Soc., Victoria, vol. VII., p. 228, t. xii., figs. 4, 5.

Eocene.—*Moorabool Valley* (*Pritchard*).

P. sp., *Tate*, 1886.

Eocene.—River Murray Cliffs (S.A.); Muddy Creek and Cape Otway (V.).

Known only by fragments of the apical part of the valves; a different species from either of the above is indicated thereby, but the material is insufficient for determinate diagnosis.

FAMILY PHILOBRYIIDÆ.

Genus Philobrya, *P. Carpenter*, 1872.

P. Bernardi, *Tate*, 1898. This Journal, vol. XXII., t. 4, f. 10, p. 88.

Eocene.—Muddy Creek, *Belmont*, and Shelford (V.).

P. prænuntia, *Tate*, 1898, *op. cit.*, t. 4, f. 9, p. 88.

Eocene.—*Cape Otway* (V.).

(To be continued).